Claims

What is claimed is:

1.   A packet flow control method for a switching node of a data transfer network, said method comprising:

actively managing space allocations in a central queue for a plurality of ports of a switching node of a data transfer network, wherein the actively managing is based on an amount of currently unused space in the central queue; and

wherein the actively managing includes determining, based on an amount of currently-vacant storage space in a storage device of a port of the plurality of ports, whether the port accepts an offered space for use by the port to buffer received data packets, the offered space comprising a quantity of the amount of currently unused space in the central queue.

2.   The method of claim 1, wherein said determining further comprises:

(i)   computing a total current credit for the port, wherein the total current credit is defined as a difference between a space allocation in the central queue for the port and an amount of the space allocation currently used to buffer the received data packets;

(ii)   comparing the total current credit to the amount of currently-vacant storage space in the storage device of the port;

(iii)   accepting the offered space if the amount of currently-vacant storage space in the storage device of the port is greater than the total current credit; and

(iv)   refusing the offered space if the amount of currently-vacant storage space in the storage device of the port is less than the total current credit.

3.   The method of claim 1, wherein said determining further comprises:

multiplying the amount of currently-vacant storage space in the storage device of the port by a scaling factor, wherein the scaling factor accounts for a difference between a first bandwidth at an input of the port and a second bandwidth between the port and the central queue.

4.   The method of claim 3, wherein said multiplying produces a scaled measure of vacant port storage space and said determining further comprises:

(i)   computing a total current credit for the port, wherein the total current credit is defined as a difference between a space allocation in the central queue for the port and an amount of the space allocation currently used to buffer the received data packets;

(ii)   comparing the total current credit to the scaled measure of vacant port storage space;

(iii)   accepting the offered space if the scaled measure of vacant port storage space is greater than the total current credit; and

(iv)   refusing the offered space if the scaled measure of vacant port storage space is less than the total current credit.

5.   The method of claim 4, wherein the scaling factor is set substantially equal to a reciprocal of a fractional portion of data that is received by the port per a unit of time that will remain in the storage device of the port for a period exceeding the unit of time due to the difference between the first bandwidth and the second bandwidth.

6.   The method of claim 4, wherein said method further comprises:

allocating, by a port credit manager, the offered space to at least one virtual lane of the port based on a space need of the at least one virtual lane if the offered space is accepted as a result of the determining.

7.   The method of claim 4, wherein:

said method further comprises reckoning amounts of unused space remaining in space allocations in the central queue allotted to virtual lanes of the port, wherein an amount of unused space remaining in a space allocation in the central queue allotted to a virtual lane of the port comprises an amount allotted to the virtual lane, but currently not used to store a received data packet; and

said computing further comprises summing the amounts of unused space remaining in space allocations in the central queue allotted to the virtual lanes of the port.

8.   The method of claim 1, wherein said actively managing further comprises:

returning the offered space back to the central queue as returned space if said determining results in a refusal of the offered space; and

adding the returned space to the amount of currently unused space in the central queue.

9.   The method of claim 8, wherein:

the returned space includes vacated allocated space in the central queue that is currently assigned to a virtual lane of the port; and

said actively managing further comprises deducting, from a current space debt of the virtual lane, an amount representing the vacated allocated space included in the returned space, wherein the current space debt of the virtual lane comprises an amount of space by which a space allocation in the central queue allotted to the virtual lane exceeds a target allocation.

10.   A packet flow control system for a switching node of a data transfer network, said system comprising:

means for actively managing space allocations in a central queue for a plurality of ports of a switching node of a data transfer network, wherein the actively managing is based on an amount of currently unused space in the central queue; and

wherein the means for actively managing includes means for determining, based on an amount of currently-vacant storage space in a storage device of a port of the plurality of ports, whether the port accepts an offered space for use by the port to buffer received data packets, the offered space comprising a quantity of the amount of currently unused space in the central queue.

11.   The system of claim 10, wherein said means for determining further comprises:

(i)   means for computing a total current credit for the port, wherein the total current credit is defined as a difference between a space allocation in the central queue for the port and an amount of the space allocation currently used to buffer the received data packets;

(ii)   means for comparing the total current credit to the amount of currently-vacant storage space in the storage device of the port;

(iii)   means for accepting the offered space if the amount of currently-vacant storage space in the storage device of the port is greater than the total current credit; and

(iv)   means for refusing the offered space if the amount of currently-vacant storage space in the storage device of the port is less than the total current credit.

12.   The system of claim 10, wherein said means for determining further comprises:

means for multiplying the amount of currently-vacant storage space in the storage device of the port by a scaling factor, wherein the scaling factor accounts for a difference between a first bandwidth at an input of the port and a second bandwidth between the port and the central queue.

13.   The system of claim 12, wherein said means for multiplying produces a scaled measure of vacant port storage space and said means for determining further comprises:

(i)   means for computing a total current credit for the port, wherein the total current credit is defined as a difference between a space allocation in the central queue for the port and an amount of the space allocation currently used to buffer the received data packets;

(ii)   means for comparing the total current credit to the scaled measure of vacant port storage space;

(iii)   means for accepting the offered space if the scaled measure of vacant port storage space is greater than the total current credit; and

(iv)   means for refusing the offered space if the scaled measure of vacant port storage space is less than the total current credit.

14.   The system of claim 13, wherein the scaling factor is set substantially equal to a reciprocal of a fractional portion of data that is received by the port per a unit of time that will remain in the storage device of the port for a period exceeding the unit of time due to the difference between the first bandwidth and the second bandwidth.

15. The system of claim 13, wherein said system further comprises:

means for allocating, by a port credit manager, the offered space to at least one virtual lane of the port based on a space need of the at least one virtual lane if the offered space is accepted as a result of the determining.

16. The system of claim 13, wherein:

said system further comprises means for reckoning amounts of unused space remaining in space allocations in the central queue allotted to virtual lanes of the port, wherein an amount of unused space remaining in a space allocation in the central queue allotted to a virtual lane of the port comprises an amount allotted to the virtual lane, but currently not used to store a received data packet; and

said means for computing further comprises means for summing the amounts of unused space remaining in space allocations in the central queue allotted to the virtual lanes of the port.

17. The system of claim 10, wherein said means for actively managing further comprises:

means for returning the offered space back to the central queue as returned space if said determining results in a refusal of the offered space; and

means for adding the returned space to the amount of currently unused space in the central queue.

18.   The system of claim 17, wherein:

the returned space includes vacated allocated space in the central queue that is currently assigned to a virtual lane of the port; and

said means for actively managing further comprises means for deducting, from a current space debt of the virtual lane, an amount representing the vacated allocated space included in the returned space, wherein the current space debt of the virtual lane comprises an amount of space by which a space allocation in the central queue allotted to the virtual lane exceeds a target allocation.

19.   A queue manager for a switching node of a data transfer network, said queue manager comprising:

central queue control logic for a switching node for tracking an amount of currently unused space in a central queue of the switching node and offering a quantity of the unused space to a plurality of ports of the switching node; and

a port credit manager for determining, based on an amount of currently-vacant storage space in a storage device of a port of the plurality of ports, whether the port accepts an offered space for use by the port to buffer received data packets, the offered space comprising the quantity of the unused space in the central queue offered by said central queue control logic and, if the offered space is accepted, allocating the offered space to at least one virtual lane of the port.

20.   The queue manager of claim 19, wherein the determining by the port credit manager further comprises:

multiplying the amount of currently-vacant storage space in the storage device of the port by a scaling factor, wherein the scaling factor accounts for a difference between a first bandwidth at an input of the port and a second bandwidth between the port and the central queue.

21.   The queue manager of claim 20, wherein the determining by the port credit manager further comprises:

(i)   computing a total current credit for the port, wherein the total current credit is defined as a difference between a space allocation in the central queue for the port and an amount of the space allocation currently used to buffer the received data packets;

(ii)   comparing the total current credit to the scaled measure of vacant port storage space;

(iii)   accepting the offered space if the scaled measure of vacant port storage space is greater than the total current credit; and

(iv)   refusing the offered space if the scaled measure of vacant port storage space is less than the total current credit.

22.   The queue manager of claim 19, wherein:

the port credit manager returns the offered space back to the central queue as returned space if the determining results in a refusal of the offered space; and

the central queue control logic adds the returned space to the amount of currently unused space in the central queue.

23.   A switching node for a data transfer network, said switching node comprising:

a plurality of data ports;

a central queue for buffering data packets received by said plurality of data ports; and

a packet flow controller, wherein said packet flow controller actively manages space allocations in said central queue for said plurality of ports based on an amount of currently unused space available in said central queue and an amount of currently-vacant storage space in a storage device of a data port of the plurality of data ports.

24.   At least one program storage device readable by a machine, tangibly embodying at least one program of instructions executable by the machine to perform a packet flow control method for a switching node of a data transfer network, said method comprising:

actively managing space allocations in a central queue for a plurality of ports of a switching node of a data transfer network, wherein the actively managing is based on an amount of currently unused space in the central queue; and

wherein the actively managing includes determining, based on an amount of currently-vacant storage space in a storage device of a port of the plurality of ports, whether the port accepts an offered space for use by the port to buffer received data packets, the offered space comprising a quantity of the amount of currently unused space in the central queue.

25.   The at least one program storage device of claim 24, wherein said determining further comprises:

(i)   computing a total current credit for the port, wherein the total current credit is defined as a difference between a space allocation in the central queue for the port and an amount of the space allocation currently used to buffer the received data packets;

(ii)   comparing the total current credit to the amount of currently-vacant storage space in the storage device of the port;

(iii)   accepting the offered space if the amount of currently-vacant storage space in the storage device of the port is greater than the total current credit; and

(iv)   refusing the offered space if the amount of currently-vacant storage space in the storage device of the port is less than the total current credit.

26.   The at least one program storage device of claim 24, wherein said determining further comprises:

multiplying the amount of currently-vacant storage space in the storage device of the port by a scaling factor, wherein the scaling factor accounts for a difference between a first bandwidth at an input of the port and a second bandwidth between the port and the central queue.

27.   The at least one program storage device of claim 26, wherein said multiplying produces a scaled measure of vacant port storage space and said determining further comprises:

(i)   computing a total current credit for the port, wherein the total current credit is defined as a difference between a space allocation in the central queue for the port and an amount of the space allocation currently used to buffer the received data packets;

(ii)   comparing the total current credit to the scaled measure of vacant port storage space;

(iii)   accepting the offered space if the scaled measure of vacant port storage space is greater than the total current credit; and

(iv)   refusing the offered space if the scaled measure of vacant port storage space is less than the total current credit.

28.   The at least one program storage device of claim 27, wherein the scaling factor is set substantially equal to a reciprocal of a fractional portion of data that is received by the port per a unit of time that will remain in the storage device of the port for a period exceeding the unit of time due to the difference between the first bandwidth and the second bandwidth.

29. The at least one program storage device of claim 27, wherein said method further comprises:

allocating, by a port credit manager, the offered space to at least one virtual lane of the port based on a space need of the at least one virtual lane if the offered space is accepted as a result of the determining.

30. The at least one program storage device of claim 27, wherein:

said method further comprises reckoning amounts of unused space remaining in space allocations in the central queue allotted to virtual lanes of the port, wherein an amount of unused space remaining in a space allocation in the central queue allotted to a virtual lane of the port comprises an amount allotted to the virtual lane, but currently not used to store a received data packet; and

said computing further comprises summing the amounts of unused space remaining in space allocations in the central queue allotted to the virtual lanes of the port.

31. The at least one program storage device of claim 24, wherein said actively managing further comprises:

returning the offered space back to the central queue as returned space if said determining results in a refusal of the offered space; and

adding the returned space to the amount of currently unused space in the central queue.

32.   The at least one program storage device of claim 31, wherein:

the returned space includes vacated allocated space in the central queue that is currently assigned to a virtual lane of the port; and

said actively managing further comprises deducting, from a current space debt of the virtual lane, an amount representing the vacated allocated space included in the returned space, wherein the current space debt of the virtual lane comprises an amount of space by which a space allocation in the central queue allotted to the virtual lane exceeds a target allocation.

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